

CUSTOMIZING IMAGE-PROCESSING in SONY HS510, HS420, XS955, and XBR960 CRT TVs

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(0) **Background:** These excellent televisions appear to be much better-engineered than what is required to reproduce the usual program material selected by consumers, especially the fine-pitch models XBR960 and XS955. But this superior image-processing chain is significantly “dumbed-down” as it comes from the factory. Fine-picture connoisseurs are thrown a few technical crumbs in the form of “None” for the disrespected velocity modulation, “Monitor” for color-decoding matrix, and “Pro,” which claims minimum “enhancements.” But even Pro mode is set up with an insensitivity to what is needed for image-processing transparency, and the factory white balance has no setting even close to the 6500K standard. So the object of our work has been to get this chassis (e.g. my 36XS955) to have at least a couple of modes that are, as much as possible, transparent to the input signal: if source video is lousy, it will *look* lousy; and if it’s fundamentally excellent, it will appear *stunning*! In addition, you can have some reasonable control to compensate for mild defects in the video -- a kind of “equalization,” to use a familiar audio term.

(1) All of the inputs and the tuner decode separate luminance (the image, minus color) and color signals. They are finally mixed to make up what is sent in analog form to the CRT display as separate red, green, and blue signals. After all of the switching, comb-filtering (composite video), decoding (digital video), noise reduction, and scan interpolation (DRC), the luminance and color signals eventually arrive at the MID system (multi-image decoder), followed by the main processor that drives the CRT, called the CXA2170 chip. It is in these two systems that the fidelity or realism of the image is mostly determined. In addition, the CXA2103 chroma-decoder chip has a sharpness/bandwidth adjustment that must be changed. Potentially, the image can be trashed by smearing the details or exaggerating them, or it can be enhanced or equalized so that the eye at a reasonable viewing distance perceives the image as marvelously realistic -- or at least as much as the originator/producer allows.

Some of Sony’s factory settings combined with the user menus let you get close to excellent, and many folks will be satisfied with what they have purchased as-is. But I believe that the marketing and other after-engineering committees at Sony have interfered at some point and dumbed-down this set in many ways. We know that they have to include a “Vivid” mode for store display to attract unsophisticated lookers and satisfy gamers and bright-afternoon football fans. But are there user settings that achieve perfection? Actually not, and that is the whole point of this document: to outline the very substantial improvements I have discovered and to make those settings plain enough so that other folks might try the same modifications. Note that it *will* require entry into the TV’s service mode.

(2) Here’s the potential you have with this set. We are assuming decent black level, color decoding, and white-balance calibration, and that the set is reasonably focused and color-converged. (Other articles cover those issues.)

(a) You have a Sharpness control slider in the user menu. But exactly *what* it applies to the image (qualitatively) is adjustable only in service mode. The Sharpness slider affects only the *amount* (quantitatively), like a sharpness volume-control with zero at the leftmost position. You can improve the “shape” of this sharpness effect so that it’s extremely useful for equalizing real-world video sources. Having accomplished that, there is no Right Setting for the Sharpness slider; you should use it to “tune” the picture to suit yourself.

(b) For luminance and color, the shaping of video-signal frequency- and time-response translates to how picture detail is rendered, both edges and texture. Some user-inaccessible parameters are set in the MID system, whose 18 characteristics (table rows) have 64 available presets (table columns) for you to tinker with in service mode’s MID5 table. These have *nothing* to do with the Sharpness slider: you have no control of this image processing outside of service mode, except to assign a couple of different setting-combinations to two different picture modes you’ve hijacked for the purpose. You get to adjust settings that control detail-softening (low-pass) filters and complex edge-sharpening enhancements, both horizontal and vertical and separately for luminance and color. You can think of the edge-enhancements as high-frequency boost; I prefer to think of them in digital-imaging terms as unsharp-masking, which they accurately resemble. Note that these settings in MID5 are *optional* enhancements; they can be very useful (and it’s only there where vertical sharpness-enhancement can be enabled). But a column of all zeroes is also valid for superb video sources, removing all enhancements in this system. (There are separate enhancements in 2170P-3 and 2103-1.)

My method has been to take over an unused column or two in the MID5 table, and use them to discover what settings result in a very neutral-looking picture from an impeccable, relatively-unprocessed source: memory stick photos and jpeg test patterns. I do this with the Sharpness slider set to 0 (minimum) so user-controlled enhancements in 2170P-3 are not in the picture. Judgments are not made with my nose 6” from the screen, but rather at a close-reasonable viewing distance -- maybe 3’ for HDTV, 5’ for DVD, and 6-8’ (on my 36” 4:3 set) for really good broadcast SDTV. I use great DVDs (Monsters, Inc. is perfect!) and fine broadcasts to judge what I’ve done. I have noted that a small amount of VM has the ability to kill the bit of ghosting that seems to be caused by any of the sharpness-enhancing solutions. Lengthy viewing of actual programs and DVDs confirms that this improved clarity is *not* at the expense of texture fidelity, either, much to my surprise. Moderation and finesse is the clue -- not something Sony provided out of the box.

(c) You can control or kill any applied velocity modulation (VM). In addition to the smooth sweep of the electron beam from left to right to make each line of the picture, controlled by electrical current in a set of magnetic coils, velocity modulation adds a little bit of energy to that sweep current that speeds it up and slows it down. The signal is selectively derived from the picture's luminance. It has the effect of clarifying (or exaggerating) vertical high-contrast boundaries between objects and other medium-coarse horizontal detail. True, you get to choose None, Low, Medium, or High in the user menu, but you have complete control how much is added for each of the Low-Medium-High settings and, more important, what it looks like qualitatively. (Yes, a little VM can be a Good Thing!)

(3) I have hijacked the Vivid mode for testing, since it is otherwise useless to me. First I set all of its parameters identical to Pro mode for the sources I normally use (5 or 6 sources). When one makes the user-menu settings identical for Pro and Vivid, you are able to switch from Pro to Vivid and see absolutely no change in the picture. None. Now you are free to alter Vivid for experimentation: while watching real-world programming, one can switch to Vivid mode to see if your latest Brilliant Idea is working. And switch back. And back to Vivid. And . . .

Q: The implication of the above is that one can get away with one or a very few presets for MID5. How come Sony, in their semi-infinite wisdom, have set up 64 possible presets in many different combinations?

A: Engineering convenience, I think. Many columns are identical. So the plan was, I assume, to have a column for each separate signal/scan combination. If some turn out the same, that's okay. Maybe some presets are designed to be complementary to the "special sharpness" settings in 2170P-3/SYSM (set to 1 or 2), which are used liberally for fairly coarse sharpening.

Some of their choices are questionable for fine sources. Why is image-softening applied in column 12 for DVD-480i (MHLY = 1), but then significant edge enhancement is added in the same column (MHYE = 2, MHYO = 1)? This certainly gives the picture a smooth "look," and it seems to help unclear SD sources be a bit more attractive; but superb SD video sources are softened a bit in the finest textures. Maybe I would want a setting like this as a *choice*, but not as a single built-in.

I see the engineering point; they're hedging their bets. But I'm having no trouble being satisfied with a few MID5 presets for everything. I have tried to learn from Sony's original settings, then to strike out on my own in columns 60 and 61. Your mileage may vary, of course.

See the tables on the next page for the best I have been able to do so far in figuring out what these various service-mode codes do for video-image rendition. The shading colors have no special significance beyond helping to identify functional groups.

Reminder (again): The settings in 2170P-3 are for each picture mode *and* for each video-input mode, over 60 possible combinations. But you are likely to use only a fraction of these. Be sure to look at the service-data chart to see what I mean, here, or you can get confused, as I did!

2170P-3 Col. 4 = Sony service-data default settings for **36XS955**, Pro mode, 480i into V5 input (DVD, component video).

No.	Code	Range	Def.	New	Code Description	Comment
0	SYSM	0-3	2	3	An overall "special" sharpening effect. 3 = OFF; 2 = medium effect; 0 = 1 = very heavy.	Determined by position of Sharpness slider . Settings of 0-2 very ugly! (Setting not retained after Write.)
1	VMLV	0-15	0	0	Temporary test setting, not saved. Temporarily adds velocity modulation (VM) so you can see how it affects the settings made elsewhere in this table. If you make a change in any other setting, it reverts to 0.	
2	VMCR	0-3	0	0	Sony call it "coring level." Can't determine effect.	These 4 settings completely control the "look" of VM, as applied by the three VM high-medium-low settings, 2170P-3/VMH-VML. If VM is set to ZERO elsewhere, these have no effect. Independent of Sharpness slider.
3	VMLM	0-3	3	3	VM limiter/clip. 3 = max = linear VM.	
4	VMF0	0-3	0	3	Detail frequency coefficient "f0." Determines scope/sharpness of VM effect.	
5	VMDL	0-15	7	0	VM delay. Above 0, increases coarseness of VM. Fattens vertical lines. Ugly, IMHO.	
6	SHOF	0-3	2	3	Primary sharpness enhancement. Amplitude increases from 0 to 3; never completely off.	These determine the "look" of sharpness-enhancement as added by the Sharpness slider . If Sharpness is set to 0, these have no effect.
7	SHF0	0, 1	1	1	"f0" coefficient, which increases coarseness of sharpening. 1 turns it OFF.	
8	PROV	0-3	3	3	Sets position of edge-enhancement for best unsharp-mask effect. Leftmost onscreen = 3; 2 thru 0 progressively move effect to right -- like a time-delay.	
9	F1LV	0-3	0	0	Adds sharpness, but easily causes ghosting. 0 = OFF.	These manipulate an edge enhancement that appears like a bit of VM or unsharp-masking. Seems too coarse to me and redundant with settings above -- except that it is independent of Sharpness slider.
10	LTLV	0-3	0	0	Adds something called "LTI level," which could be construed as aperture correction. But very fine detail suffers slightly, and the effect seems coarse and unnatural. 0 = OFF.	
11	LTMD	0, 1	1	1	Determines position of effect above relative to detail edge. No effect if LTLV = 0.	
12	CTLV	0-3	0	0	"CTI level." Seems to have insignificant effect. 0 = OFF.	
13	UBOF	0-7	2	0	Brightness	Mode/input/scan-dependent offsets for the user Brightness, Color, and Hue sliders. Use to equalize inputs so you don't see shifts when switching.
14	UCOF	0-7	0	0	Color	
15	UHOF	0-3	0	0	Hue	
16	MIDE	0-63	12	60 or 61	Points to column in large MID5 table, whose settings determine the rest of the image processing (see below).	60 for HD material and DVD thru V5/V6. 61 for SD video.

MID5 Defaults for MID5 col. 12 are for 36XS955. Cols 60 and 61 were "taken over" for our purposes. All effects are *independent* of Sharpness slider.

No.	Code	Range	Def.	New1	New2	Code Description	Comment
0	POP	0-63	12	60	61	Temporary sets the column in which you are working, so you can make changes easily.	(Setting not retained after Write.)
1	MHLY	0-3	1	0	0	Horizontal luminance.	High-frequency attenuation (low-pass) filters for image detail. 0 = OFF. Increasing blurring/smoothing from 1-3. Probably useful for suppressing grain in coarse images, but I don't like any of it for fine sources.
2	MHLC	0-3	3	0	0	Horizontal color.	
3	MVLY	0-3	0	0	0	Vertical luminance.	
4	MVLC	0-3	0	0	0	Vertical color.	
5	MHYR	0-3	0	0	0	"Core." Undetectable effect.	Horizontal luminance detail enhancement. Acts like unsharp masking. I have never figured out what "core" means.
6	MHYL	0-3	1	3	3	Clip level. 3 = max = linear.	
7	MHYE	0-7	2	7	3	Enhancement amount; 0 = none.	
8	MHYO	0, 1	1	0	1	Multiplier coefficient - about 4X	
9	MHCR	0-3	0	3	0	"Core." Undetectable effect.	Horizontal color detail enhancement. Only very subtle effect on real program material.
10	MHCL	0-3	0	3	3	Clip level, 3 = max = linear.	
11	MHCE	0-7	0	1	1	Enhancement amount; 0 = none.	
12	MHCO	0, 1	0	0	0	Multiplier coefficient - about 4X	
13	MVYR	0-3	0	0	0	"Core." Undetectable effect.	Vertical luminance detail enhancement. Much program material already has some of this built-in. Use conservatively or not at all.
14	MVYL	0-3	0	0	0	Enhancement clip level. 3 = max. 1 has very slight effect even with MVYE at 0.	
15	MVYE	0-7	0	0	0	Enhancement amount. 0 = none.	
16	MVCR	0-3	0	0	0	"Core." Undetectable effect.	Vertical color detail enhancement. Only very subtle effect on real program material.
17	MVCL	0-3	0	0	0	Enhancement clip level. 3 = max.	
18	MVCE	0-7	0	0	0	Enhancement amount. 0 = none.	

(0) The effects of the custom settings in the “New” column of the 2170P-3 chart above were studied first in test images, then by living with them and viewing actual program material of all types over a few weeks. The settings were modified again and again, and they are certainly on perpetual probation. They represent a very successful “home base.” If one corrects the Brightness and Sharpness sliders for individual program material, these settings vastly improve on what the 36XS955 could display out of the box!

Compared to MIDE = 60, 61 is a bit sharper for very fine detail, and I have assigned it for all 480i and 480p SD inputs (but not DVD). For 1080i and 720p inputs, MIDE = 60 seems a better balance for material that inherently needs less sharpening or more fine-grained sharpening. The combination of settings in MHYE and MHYO are the most critical and deserve tinkering. Think of MHYO as a coarse adjustment in sharpness, and MHYE as fine adjustment.

(1) I have set velocity-modulation amounts for *all* picture modes as follows: 2170P-3 / VM = 0, VML = 3, VMM = 6, and VMH = 9. Big surprise: As “shaped” by the settings in 2170P-3 above, small amounts of VM (Low or Medium) *significantly enhance* the image without smearing any fine detail. Try it based on actual pictures. For one thing, it tends to suppress edge-ghosting without adding some kind of penalty. I know “everybody” badmouths VM, but be open-minded here: a little seems only to improve the picture. A whole lot is ugly! But you get to control it in the user menu to suit yourself.

(2) The native gamma for a 36XS955 in Pro mode measures about 2.45 -- a bit high for any TV standard. Although it definitely enhances flatly-lighted SD programs, it's unnaturally high for some DVD and broadcast-HD material. Changing the gamma settings in at least one of the picture modes to 0 for (2170P-4) GAMS and 3 for each of GAMR, GAMG, and GAMB yields a gamma = 2.2 on my set, the standard for television studio monitors. I used Movie mode for this. There are some arguments, however, that broadcasts pre-compensate for the 2.4+ gamma, yielding a real 2.2-ish. Bottom line: the setting that looks best **is** best. Some HD dramas are *very* dark, and gamma = 2.2 improves them.

(3) With the custom settings above, Sharpness-slider settings of 10-25 generally compensate most decent video sources without adding artifacts or excess edginess. Adjust for best realism at normal viewing distance.

(4) There were considerable differences among my usual program sources for black level. Component outputs from various sources can have wildly differing black levels. My highest was a Toshiba DVD player thru input V5, and so I set the Brightness slider to 31, 2170P-3/UBOF to 0, and calibrated 2170P-1/SBRT to a pluge pattern from the Digital Video Essentials DVD. Other inputs were matched to it visually using 2170P-3/UBOF for each of my working inputs and for each picture mode per input.

(5) I have had mixed feeling about vertical (line-to-line)sharpness enhancement. In MID5, #14/MYVL = 1 adds just a tiny bit, and I have lived with it for months. But I finally have decided it does have enough finesse to justify its use. Where program material is already sharp, it adds an artificial quality to horizontal detail So I have now set all vertical enhancements to zero, MID5 #13-18.

(6) There are very substantial sharpness/frequency-response corrections in the chroma-decoder chip CXA2103. In the code group 2103-1, the relevant items are #6-8, SHAP, SHF0, and PRE0. The amount of sharpness applied here is determined by SHAP, and I would initially leave this alone, as the factory defaults seem nearly perfect. But the *coarseness* of the sharpening (SHF0) and how it is positioned at brightness transitions (PRE0) seem way off. Changing all of the values of SHF0 to 2 and PRE0 to 1 have made a noticeable improvement in DVD video, SD analog, and SD digital. *Very important:* High-definition video from the tuner and memory-stick images are *unaffected* by these settings. I can't speak for HD from component inputs. The service-data chart shows that these parameters have to be changes for five video input types: SD tuner (analog *and* digital), Composite/S-video (V1-V3), component video (V5, V6), and HDMI.

For HD video of any source, you can test whether the 2103 adjustments are necessary. Watch the picture and temporarily adjust 2103-1 #0/YLEV upwards (write down the original setting), and check if the picture becomes brighter. If so, restore the setting for YLEV (press 0 - Enter on the remote), and then make the SHF0 and PRE0 changes above. If not, the 2103 chips isn't even in the video loop.

(7) Finally, one can make a case for using absolutely no MID-system enhancements at all, and just increasing the Sharpness slider a bit. I have set up a column in MID5 with all zeroes: POP = 63. Comparing fine DVD or HD images between MIDE = 60 (as in chart above) and Sharpness slider at 12 with MIDE = 63 and Sharpness at 20 is interesting. The video seems of equivalent quality, with possible fewer sharpening artifacts for the latter condition. For really excellent video (and that excludes probably all SD video), maybe MID-enhancement-free is the way to go. Your choice, as always.